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BY

CHARLES BRANCH WILSON

Of the Department of Biology, State Normal School, Westfield, Massachusetts

No. 1928.—From the Proceedings of the United States National Museum,
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INTRODUCTORY.

During the summer of 1911 the author traveled nearly the entire length of the Cumberland River in the interests of the United States Bureau of Fisheries. While the party was studying especially the fresh-water mussels of the river, there were frequent and excellent opportunities for collecting the Odonata.

These opportunities were improved as far as possible, and a list is here presented of the different species obtained, together with their observed range and habits. This is the first attempt, so far as known, to report the dragon flies of this particular locality, and it must of necessity be very incomplete, but it is hoped that it may at least form a foundation for future observation, and give a general idea of the odonate fauna of the region. Having had previous experience with river collecting, a small .22-caliber rifle and cartridges loaded with dust shot were provided in addition to the usual collecting outfit. Such species as could not be secured in any other way were brought down with the dust shot. These were usually mutilated and of no use for museum purposes, but scarcely one of them was injured enough to render it incapable of identification, which is all that is required for determining the fauna of the valley. The general itinery of the trip, so far as the Odonata were concerned, was as follows: Starting at Jellico, Tennessee, June 28, 1911, on the Clear Fork of the Cumberland River, the party worked the upper portion of the river as far down as Burnside, Kentucky, from various railroad centers. Thence they proceeded by boat down the river through Kentucky and into Tennessee as far as Clarksville, a distance from Jellico of about 600 miles. Side trips were also made up all the tributary rivers, streams, and creeks of any size. Constant watch was kept for both dragon flies and damsel flies, and specimens were collected at different places on the river bank in addition to the specimens taken from the

boat all the way along. The specimens of dragon flies were identified on the spot, that there might be no fading of colors, and were then shipped by mail. One large box, containing specimens from the lower part of the river, was lost in transit. While a list of the species had fortunately been kept, the exact localities and dates were lost. These have been supplemented so far as possible from the notebook, but there is still somewhat of a dearth of localities from the lower river, which did not really exist.

For the opportunities thus enjoyed, as well as for permission to publish the present paper, the author tenders sincere thanks to the honorable Commissioner of the Bureau of Fisheries.

LIST OF SPECIES.

1. TACHOPTERYX THOREYI (Hagen).

A male and a female of this large species were obtained near the Great Falls of the Cumberland, one on July 5, the other on July 8. The former, the male, was captured on the bank of the river; the latter was 10 miles away in a sunny place beside the stage road and at a considerable elevation among the mountains. Both were easily captured while resting, for there is no difficulty in approaching them at such times, as has been noted by Williamson and others. But while hunting their prey they are strong and swift fliers, and their habits much resemble those of *Æshna* or *Anax*. From these and other large species they can be distinguished, even while flying, by their brown markings in place of blue or green or yellow. Many besides those captured were seen while driving 14 miles along this same road.

2. GOMPHOIDES OBSCURA (Rambur).

This species was very common on the Clear Fork of the Cumberland River at Jellico, Tennessee, June 28, and a dozen of each sex were obtained. Another single specimen was captured on the Big South Fork of the Cumberland near Parkers Lake post office July 9. Both sexes rest much of the time upon the sand on the river bank in the bright sunshine. They are easy to approach and capture at such times and are not as swift fliers as many of the gomphines.

3. GOMPHUS VASTUS Walsh.

One female was taken at the Great Falls of the Cumberland, July 6, and a male and female were obtained on July 18 at Indian Creek Landing, Russell County, Kentucky. The greatly dilated seventh, eighth, and ninth segments and the bright yellow on the sides of the ninth segment are conspicuous even in flight.

The species was common at least down to the State line between Kentucky and Tennessee. It is quite active and the males are hard to capture, since they persist in alighting amid the brush near the water's edge.

4. GOMPHUS NOTATUS Rambur.

A single male was captured at the Great Falls of the Cumberland, July 5. It was flying up and down the river over the swift water just above the falls. It is a very strong flier and is exceptionally active, remaining a long time on the wing. Indeed, this one did not alight at all during the hour that it was watched. The species is comparatively rare, since no other specimens were seen during the summer.

5. GOMPHUS SPINICEPS (Walsh).

A single female was captured in the long grass on the banks of Greasy Creek in Russell County, Kentucky, July 17. Quite a number of specimens were present in the immediate vicinity, but it was practically impossible to detect any of them before they flew up out of the grass. The one obtained was caught accidentally while sweeping the grass for damsel flies. It is a strong flier and frequents the vicinity of riffles, where the water flows rapidly over small stones. It is recorded by Williamson from Tennessee.

6. GOMPHUS DILATATUS Rambur.

A single female was taken at Jellico, Tennessee, June 28, on the Clear Fork of the Cumberland. This is one of the larger species, but did not prove so difficult to capture, since it may be approached with comparative ease while at rest. Several other specimens were seen at the same locality, but it was not found anywhere else during the summer.

7. GOMPHUS PLAGIATUS Selys.

This species was common all along the river from Burnside, Kentucky, to Nashville, Tennessee. It frequents the riffles, flying back and forth over the swift current, and is seldom seen in the long stretches of quiet water between. Frequently it dives into the water for its prey, plunging entirely beneath the surface. It immediately comes forth, spreads its wings, and flies away into the very top of one of the tallest trees along the river bank, there to enjoy its meal in quiet security.

It very seldom alighted on the shore and proved difficult to capture, all the specimens having to be shot either while hovering over the water or while munching their prey in the trees.

It may be recognized when flying near at hand by the reddish-brown posterior end of the abdomen, which stands out in good contrast to the darker color of the rest of the body. About a dozen specimens were obtained at various riffles on the river in Russell, Cumberland, and Monroe Counties, Kentucky, and Clay and Jackson Counties, Tennessee. In hovering over the water the abdomen is not elevated, as in the following species, but is held nearly horizontal.

8. GOMPHUS PALLIDUS Rambur.

This species was also fairly common at the riffles, but unlike *plagiatus* it frequently alighted on the river bank and was then comparatively easy to capture. Several teneralis were secured at Cloyds Landing, Monroe County, Kentucky, that had just emerged on the morning of July 23. Four of the larvæ crawled out on the boat during the night, and the soft imagoes were found alongside the exuviae the next morning.

This species first appeared at some riffles about 30 miles below Burnside, but quickly became common.

It flies comparatively slowly and hovers a great deal; its wings have a yellowish tinge, very visible when hovering; it often plunges entirely beneath the water when capturing its prey, and then mounts high in the air and seeks the tops of the tallest trees. When it alights on a pebbly beach it hovers a moment and apparently feels the rock, testing it before settling, and meanwhile holding its abdomen pointing upward. It then settles down slowly, lowering the abdomen until it is flat against the rock. In this position its colors harmonize so well with its surroundings that it can be seen only in a favorable light. It also frequently alighted on the boat, holding its abdomen elevated at an angle of about 45°.

9. DROMOGOMPHUS SPINOSUS (Selys).

This species was common on the upper part of the river from the Great Falls down to the State line. It was also obtained on the Big South Fork, opposite Parker's Lake post office, in Pulaski County, Kentucky. On the main river specimens were obtained at Burnside, Mill Springs, Indian Creek Landing, Cloyd's Landing, and Black's Ferry. It is quite active but alights frequently along the shore and can then be captured. It is not confined to the vicinity of rapid water like the two preceding species, but is found anywhere in sunny localities, usually on rocky ledges. Like the preceding species it dives into the water for its food, but is satisfied with ordinary underbrush or even the rocks as a dining place. In ovipositing the females skim along very swiftly close to the surface of the water, which they touch with the tip of the abdomen at long intervals, without visibly checking their speed, after the manner of *Macromia*.

A male taken at Black's Ferry had the dorsal surface of the tenth segment washed with greenish-yellow like the female.

The newly emerged imago has a decidedly yellow dorsal stripe; this then becomes olive, and in the old males gradually disappears leaving the abdomen almost entirely black.

10. BOYERIA VINOSA (Say).

A single male was captured July 5 at the Great Falls, and two other individuals were seen in the immediate vicinity. It was also

found sparingly at different points on the river, notably at Indian Creek Landing, July 19, and Black's Ferry, July 24.

It frequented the thicker woods where the trees overhung the water. Here both sexes were found attached to the under side of twigs in close proximity, after the manner of *Macromia*, and when disturbed they returned to the same spot again and again.

11. *MACROMIA ILLINOIENSIS* Walsh.

The most common of all the dragon flies, it is seen everywhere up and down the river, in quite sunny places as well as at the riffles.

It is a very rapid flier, especially when frightened, or when chasing its prey or other dragon flies, and it never hovers and rarely alights. When two of them come together from opposite directions a fierce fight often takes place, and one of the contestants is sometimes thrown into the water. They are constantly upon the wing in search of food, and they fly so rapidly and dodge so quickly that it is next to impossible to catch one in a net. But they have a habit of congregating in favorite spots among the low bushes, often in company with *M. tæniolata*. Here they hang by their legs from the under side of the branches, sometimes several individuals occupying the same branch. Even then it is difficult to get up to them with a net, but they can be easily approached near enough for shooting.

In this way a dozen specimens of this and the following species were obtained within 20 minutes in the low bushes beside the wagon road leading to the ferry at Cairo, Wilson County, Tennessee, August 19. A curious habit was also noted: About sunset they resort to the cornfields on the river bottoms and patrol them until dark. In doing this they fly between the rows of corn about 3 feet above the ground, going up one row and down the next with remarkable regularity. This habit was observed on many different occasions; indeed, scarcely a cornfield was visited at that time of day without seeing one or more of these *Macromias*.

12. *MACROMIA TÆNIOLATA* Rambur.

This larger species in every way resembles the smaller preceding one. When on the wing the two show scarcely any difference except their relative size. These larger ones are veritable hawks, intensely rapacious, swift enough to catch and strong enough to overpower and eat almost any insect, even some of the *Gomphus* species already mentioned. They not only congregate with *M. illinoiensis*, but their habits are exactly the same. Two of the specimens mentioned above were brought down with one shot, while hanging so close together that they almost touched. On examining them one was found to be a *tæniolata* and the other an *illinoiensis*. Different species of dragon flies do not usually mingle thus intimately, especially when there is such a disparity in their size.

Like *illinoensis*, this species was found the entire length of the river below Burnside, not numerous at any one place, but evenly distributed throughout.

13. *SOMATOCHLORA TENEBROSA* (Say).

A single female was captured near the Big South Fork, opposite Parkers Lake post office, July 9. Ten or a dozen specimens of this species were patrolling back and forth just after sunset in one corner of an old pasture near a small brook at the foot of the mountains. They were strong and rapid fliers and extremely difficult to capture. They moved gracefully up and down and in and out, weaving together their paths of flight like the intricate mazes of an old-fashioned dance. But never for an instant could they be caught off their guard. At the first attempt of the net they all retired precipitately, and it was a long time before they returned again. This is a northern species and its presence in Kentucky is probably explained by the high altitude of the region where it was found and the proximity of the mountains.

14. *EPICORDULIA PRINCEPS* (Hagen).

A single specimen of this species was seen on the afternoon of July 20 near Burkesville, Kentucky. It suddenly appeared, apparently from nowhere, and alighted on the boat within arm's length of the author; but, of course, at the first movement it was gone, and it did not return.

15. *ANAX JUNIUS* (Drury).

Several specimens were seen at long intervals, one at Indian Creek Landing, July 15; another at Sandersville Ferry, just above Nashville, Tennessee, August 18; a third at Lock No. 5, Wilson County, Tennessee; and a fourth near Clarksville, Tennessee, August 27.

Each was patrolling the bank of the river, but none of them was captured.

16. *PANTALA HYMENÆA* (Say).

A male and female were captured at the Great Falls, July 7. They were very common around the falls and congregated in considerable numbers over the swift water after sunset. They fly rapidly and are agile dodgers. Apparently they never alight except for the night, but continue moving about restlessly and eating whatever they catch while still flying. One could often be seen to catch an insect and eat it while looking for more.

Occasionally one would mount spirally into the air until lost to view, and of course it was impossible to tell whether that one came back again to continue the hunt; but at all events the numbers did not diminish until they all disappeared at about the same time. This species was also seen at various places along the whole length of the river.

17. *TRAMEA ONUSTA* Linnæus.

A single female was captured at Fishing Creek, Kentucky, July 15. Several others were seen in the vicinity, the dark bases of the posterior wings serving to identify them when everything else in sight had hyaline wings.

18. *PERITHEMIS DOMITIA* (Drury).

This tiny dragon fly was first seen on the river at Fishing Creek, Pulaski County, Kentucky. Afterwards it appeared every now and then all the way down the river to Clarksville, Tennessee, becoming more numerous after passing the State line.

The males were seen upon the main river, while the females were on the side creeks or in the fields at some distance from the water.

19. *LEUCORHINIA INTACTA* (Hagen).

This dragon fly, familiarly known as "Johnny White-face," was found only around the fresh-water ponds or on the side creeks; there were none on the river. Some of the localities where specimens were taken were Fishing Creek, Greasy Creek, Indian Creek, and Cloyds Landing, in Kentucky; Roaring River, Spring Creek, and Marrowbone Creek, in Tennessee; and around the pond at Sandersville Ferry, Tennessee.

20. *ERYTHEMIS SIMPLICICOLLIS* (Say).

Like the preceding, this species was found only around ponds, and its presence was always indicative of a pond or swamp in the vicinity. It was fairly common at Indian Creek Landing, and at that time (July 17) the males had not become pruinose.

At Sandersville Ferry large numbers of the species were congregated around the pond and even along the river bank for some distance above and below. By this time (August 17) the males had become entirely pruinose.

21. *PACHYDIPLAX LONGIPENNIS* (Burmeister).

Found in considerable numbers at Jellico, Tennessee, on the Clear Fork of the Cumberland River, June 28, and even at this date all the males were wholly pruinose. The species was subsequently taken on the Big South Fork near Burnside, at Greasy Creek, Cloyd's Landing, Butler's Landing, Carthage, Nashville, and Clarksville.

22. *LIBELLULA LUCTUOSA* Burmeister.

A single male was captured and several specimens of both sexes were seen at Indian Creek Landing, July 17, around the small pond. The species were seen at each of the other ponds visited, but none were found on the river.

23. *LIBELLULA CYANEA* Fabricius.

Two males were captured on the Clear Fork at Jellico, Tennessee, June 28, and another male at the small pond at Indian Creek Landing, Kentucky, July 17. One or two females were seen in inaccessible places where they could not be captured.

24. *LIBELLULA PULCHELLA* Drury.

This large and well marked species was seen but very few times during the season, once on the Big South Fork near Burnside, July 11, a second time near the small pond at Indian Creek Landing, July 17, a third time near Gainesboro Landing, and finally near Hartsville, August 15. It seems remarkable that a species so cosmopolitan as this should be so little in evidence for the whole length of the river.

25. *PLATHEMIS LYDIA* (Drury).

This species was found everywhere, not on the river but up the tributary creeks and around the little pools and ponds in the pastures and fields. The first one was taken at Jellico, Tennessee, June 28, and the last one at Clarksville, Tennessee, August 30. Specimens could have been secured at every stopping place in Kentucky and Tennessee, but the males are so easily distinguished while flying as to obviate the necessity of their capture. It is seen only rarely on the river banks.

26. *AGRION MACULATUM* Beauvois.

Common along all the smaller shaded creeks running into the Cumberland, but never appearing on the main river. Among the localities from which specimens were obtained are Williamsburg, Kentucky, June 29; Big South Fork, Beaver and Greasy Creeks, Cloyd's Landing, Roaring River, Carthage, Hartsville, and Ashland City, Tennessee, August 27. Probably every creek and run between these geographic and time extremes would have yielded specimens. A great difference was noted in the ease with which this species could be approached at the different localities. At Williamsburg and on Beaver Creek and at Hartsville one could walk up and seize them with his fingers. At Roaring River and Ashland City it was almost impossible to get near enough to catch them with the net.

27. *HETÆRINA AMERICANA* (Fabricius).

This species was common everywhere along the upper portion of the river in the vicinity of swiftly running water. It is especially fond of shallow rocky ripples, either in the main river or in any of its tributary streams. Some were captured at practically every one of the ripples visited, but the numbers diminished in descending the river, until at the State line there were comparatively few. The last one seen was secured at Rome in Smith County, Tennessee. As *americana* diminished and finally disappeared the following species, *H. tricolor*, appeared, increased in numbers, and finally took the place of *americana*.

Both of these species fly until October, so that this difference in their distribution can not be attributed to seasonal changes, but must be geographical.

H. americana is a species whose range extends to the north and so frequents the upper portions of the Cumberland River among the mountains.

28. *HETÆRINA TRICOLOR* (Burmeister).

This species first appeared at Celina, Tennessee, a little way below the State line. It then rapidly increased in numbers and gradually replaced *americana*, becoming the most common agrionine of the lower portions of the river.

It does not assemble in such large numbers as *americana*, and is much more difficult to capture, but otherwise is almost identical in its habits, and it frequents similarly the bushes along shallow rocky ripples. It is a southern species and so is found on the lower portions of the river among the lowlands.

29. *LESTES RECTANGULARIS* (Say).

The only species of the genus *Lestes* seen during the season was captured on the shore of the small pond at Indian Creek Landing. Both sexes were found in the dense underbrush on the shores, which they seemed to prefer.

30. *ARGIA MOESTA PUTRIDA* (Hagen).

This is one of the three common species of *Argia* found everywhere along the entire length of the river and on such of its tributaries as were visited. It does not occur in as great numbers as the following species, and is not so conspicuous in consequence of the lack of blue at the tip of the abdomen.

But it is much like them in habits and frequents sunny places on the river bank, usually alighting on the ground, on sticks, or on stones. The younger females are pale brown, in such contrast to the blue head and thorax of the fully matured adult that they look like a different species.

31. *ARGIA APICALIS* (Say).

This is by far the most common damselfly on the river, and during the whole season it was found in great numbers wherever the Odonata were hunted. It was as abundant on the upper river among the mountains as farther down in the lowlands.

It seems to prefer a floating chip or a board at the level of the water for oviposition. Around such places the pairs congregate, the females grasping the edge of the chip and thrusting their abdomens as far as possible beneath the water, the males holding themselves erect and perfectly straight above the neck of the female. Often the chip is covered so completely that there is not room for even one more couple. It then looks as if it were covered with a dense growth of moss, having spots of bright blue on every stem. This species was not seen to submerge itself while ovipositing as is frequently done by the preceding species.

32. *ARGIA TIBIALIS* (Rambur).

Not as abundant as *apicalis* but occurring in about the same numbers as *putrida*. The three were found everywhere together, but *tibialis* seemed to prefer vegetation more than the other two, and did not stick so closely to the open sunny spots. The fact that

only two of the posterior segments are blue dorsally renders this species less conspicuous than *apicalis*.

It was rather more common during July on the upper portions of the river, and diminished somewhat in numbers during August on the lower river.

33. *ARGIA TRANSLATA* Hagen.

Found in company with the three preceding species, but preferring shady and secluded spots amongst dense vegetation rather than the sunny open. This is rather more of a southern species than the others, but did not occur in such abundance as *apicalis*. Furthermore none were seen ovipositing in company with the other species, but always in secluded places by themselves. A few specimens were found in every locality the whole length of the river, but it seemed more plentiful during August on the lower river.

34. *ARGIA SEDULA* (Hagen).

This bright-colored species was found in dense vegetation along the banks of small creeks and streams, often in company with *Agrion maculatum*. It was never found in any numbers—only straggling specimens—but was universally distributed throughout the river and during the entire summer. It is a more showy species than even *apicalis*, the wide black stripes on the blue thorax standing out conspicuously.

35. *CHROMAGRION CONDITUM* (Hagen).

Two females were taken in company with *Agrion maculatum* at Ashland City, Tennessee. They were on the shady bank of a small creek flowing into the Cumberland River, and were the only specimens seen during the entire season.

36. *ENALLAGMA EXSULANS* (Hagen).

Only two lots of this species were taken, one on the Big South Fork, July 9, and the other at Nashville, Tennessee, August 21.

The latter was near a small pond; the former was on the river bank. This highly-colored species, therefore, does not seem very common since it could hardly escape notice if present at any of the other localities visited.

37. *ENALLAGMA GEMINATUM* Kellicott.

A single specimen of this small species was taken on the Big South Fork in company with the preceding species, and none were seen at any of the other localities.

38. *ISCHNURA POSITA* (Hagen).

This tiny damselfly was found only around the small ponds at Indian Creek Landing, Kentucky, and near Nashville and Clarksville, Tennessee. Both sexes were taken at each of these localities, but none were seen on the river or any of its tributaries.

39. *ISCHNURA VERTICALIS* (Say).

Found at the small pond near Nashville, Tennessee, August 21, and also near Clarksville, one week later. It was not found anywhere on the river or on any of its tributaries.

SUMMARY.

Certain facts must be carefully considered before any conclusions of real value can be drawn.

1. While collecting was done at all times of day, from early dawn until long after sunset, yet the examination of any one locality was confined to a few hours, or at the most to a day or two.

The results, therefore, will be general, applicable to the whole river or large portions of it, rather than specific for any locality.

2. The collecting did not begin until the very last of June (the 28th); almost the whole of the best dragon fly month of the year was thereby lost, and thus the author failed to obtain some species at least that must have been present earlier in the season.

3. There was a continual progress in the localities visited, seasonally, from late in June until early in September, and geographically from the Jellico and Pine Mountains in the extreme eastern part of Kentucky through the Cumberland plateau of central Kentucky and Tennessee to the lowlands of the western portion of the latter State. Such a combination of different localities, different dates, and different elevations would preclude any data with reference to seasonal distribution. My conclusions, therefore, must be general rather than specific, geographical rather than seasonal, and must deal with the habits and habitat of the various species, and not so much with their local distribution or relative abundance. In accordance with these suggestions the following may be fairly deduced:

1. Of the dragon flies here named it may be stated that the river is entirely patrolled by the two species of *Macromia*, by two of the *Gomphus* species, *plagiatus* and *pallidus*, and by *Dromogomphus spinosus*.

2. The two species of *Macromia* are to be found everywhere, over still water as well as at the ripples, on the river, along the banks, and in the fields at some distance from the water. Although not as numerous as some of the other dragon flies, nor bunched together in restricted areas like the species of *Gomphus*, the large size of these *Macromias* and their superior agility easily give them the supremacy, and they are admittedly the king dragon flies of the Cumberland Valley.

3. At the ripples the species of *Gomphus* are very much in evidence, the dark-colored *plagiatus* and the light-colored *pallidus* far surpassing all the others in their geographic range, as well as in actual numbers at any one place. They are the patrols of the swift water and are almost never seen except in its immediate vicinity. While not as powerful nor as active as the *Macromias*, yet their influence is greatly enhanced by this habit of congregating in considerable numbers at definite localities.

4. The function of *Dromogomphus* is that of a filler-in or supplementer. Along the quiet reaches of the river it completes the work of the *Macromias*, at the ripples that of the two species of *Gomphus*, and everywhere it makes good the deficiencies and omissions of these other dragon flies. Although often far more numerous than the *Macromias*, its inferior size and agility compel it to be satisfied with second place. And at the ripples, while it could hold its own with either species of *Gomphus* on equal terms, it is always greatly outnumbered.

5. Among the damsel flies the two species of *Hetærina* occupy the same position as the *Macromias* among the dragon flies. While they are found in greater numbers near swift water, they nevertheless cover practically the entire river. But there is this difference, that the species are separated, *americana* occupying the upper portions of the river among the mountains, while *tricolor* is found in the lowlands farther down. The species, therefore, can not be counted as two in comparison with those of *Macromia*, but only as one.

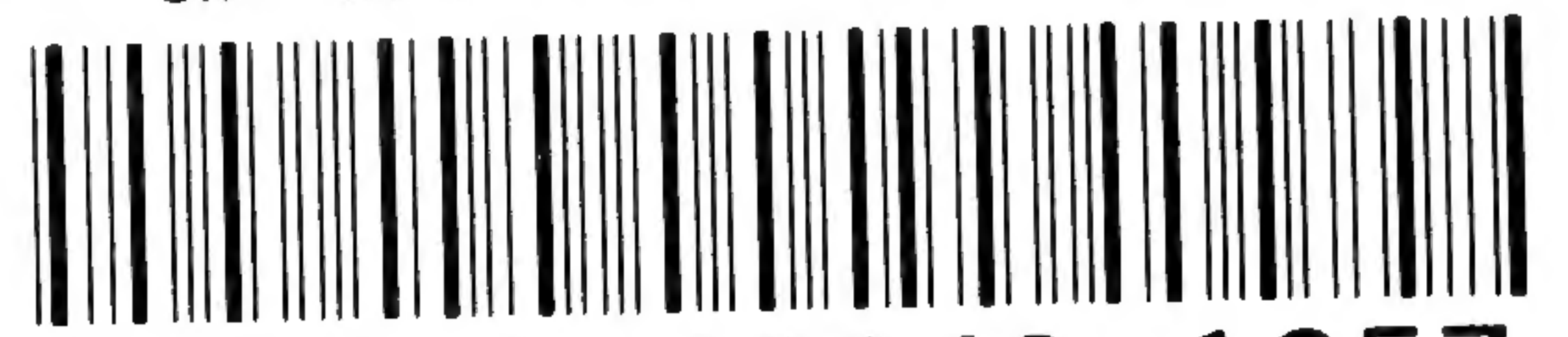
6. Four of the species of *Argia*, namely, *moesta putrida*, *apicalis*, *tibialis*, and *translata*, correspond very well with the two species of *Gomphus*.

While they are not confined to the vicinity of swift water, like those dragon flies, they do congregate in considerable numbers at favorable localities.

7. The odonate fauna of the Cumberland River is thus made up practically of these five dragon flies and six damsel flies, and all the other species here enumerated are in a measure incidental or accessory.

8. The general course of the Cumberland River is a crescentic curve, convex toward the south, so that the mouth is practically on the same parallel as the source. Nevertheless the combination of mountains, an elevated plateau, and lowlands results in a corresponding combination of northern, cosmopolitan, and southern species in the odonate fauna.

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